

## CASE REPORT

## Paradoxical embolisation of a catheter fragment to a coronary artery in an infant with congenital heart disease

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### Abstract

**Six weeks after cardiac catheterisation via the right femoral vein an infant underwent an anatomical correction for transposition of the great vessels and closure of a large ventricular septal defect. The patient died intraoperatively as a result of severe left ventricular dysfunction. Necropsy showed an old myocardial infarction associated with thrombosis of the circumflex coronary artery. Electron probe x ray analysis showed that foreign refractile material within the thrombus contained bismuth, an element used in the construction of some cardiac catheters. This is believed to be the first report of "paradoxical" coronary embolisation of catheter-derived material and highlights the usefulness of electron probe x ray analysis.**

### Case report

A six week old infant presented to Birmingham Children's Hospital with a three week history of poor feeding and failure to thrive. On examination he was cyanosed and in heart failure. Echocardiography showed situs solitus, atrioventricular concordance, ventriculoarterial discordance (complete transposition of the great arteries), and a large perimembranous ventricular septal defect. Left ventricular fractional shortening was 35% (normal range 25-42%) with uniform function. At cardiac catheterisation a small patent foramen ovale was found but could not be crossed with a septostomy catheter. However, after a guide wire was passed across the foramen it was possible to cross the septum with a Mullins's sheath. A blade septostomy was performed with a Park Blade and this was followed by a balloon atrial septostomy. The left atrial pressure fell from a mean of 20 mm Hg to 11 mm Hg and the right atrial oxygen saturation rose from 43% to 79%. The aorta was not entered. The patient remained stable throughout the procedure.

The next day he appeared pale and sweaty and became pyrexial. Echocardiography showed an adequate septostomy but the left ventricular function was impaired (fractional shortening 22%). The electrocardiogram showed ST segment depression and T wave inversion in all leads. A clinical diagnosis of

sepsis was made and he was treated with antibiotics. His condition rapidly improved and he was discharged within a week.

Three weeks later he was admitted with a febrile illness associated with lymphocytosis. Viral studies were negative and over the subsequent three weeks his temperature resolved. A repeat echocardiogram showed that left ventricular size and fractional shortening (36%) had returned to normal. Six weeks after catheterisation he underwent an arterial switch repair with closure of the ventricular septal defect. The operation was technically successful but it was impossible to discontinue cardiopulmonary bypass because of severe left ventricular dysfunction. The patient died.

At necropsy, sectioning of the left ventricle showed a transmural fibrous scar, 2.5 cm across, in the apical portion of the posterior wall. The anastomotic lines of the great vessels were intact and the coronary ostia were patent. The coronary artery anatomy was type D according to the Yacoub classification of transposition of the great arteries—that is, the right coronary artery and the circumflex coronary artery arose from the right posterior sinus and the left anterior descending coronary artery from the left posterior sinus. Examination under a dissecting microscope showed that a 1.5 cm length of the circumflex artery was occluded where it lay in the atrioventricular sulcus. Histological examination of the posterior wall of the left ventricle confirmed an infarct that was several weeks old. There was no evidence of myocarditis. Organised thrombus with partial recanalisation was found within the circumflex artery (fig 1A). Higher power magnification showed giant cells containing refractile foreign material within the thrombus (fig 1B). This material was analysed by electron probe x ray analysis<sup>1</sup>: paraffin sections of the circumflex artery were examined in a Joel 100 CX electron microscope in the back-scatter mode. Analysis by energy dispersive x ray analysis (Link Systems) showed the presence of both iron and bismuth (fig 2).

### Discussion

The day after cardiac catheterisation the infant was unwell and in retrospect it became clear that he had sustained a myocardial infarction during the procedure. In transposition of the great arteries extensive infarction of the left

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Figure 1 (A) An organised and recanalised thrombus in the circumflex artery (elastic van Gieson, original magnification was  $\times 48$ ). (B) Giant cells within the thrombus containing particles of refractile material (haematoxylin and eosin, original magnification was  $\times 480$ ).

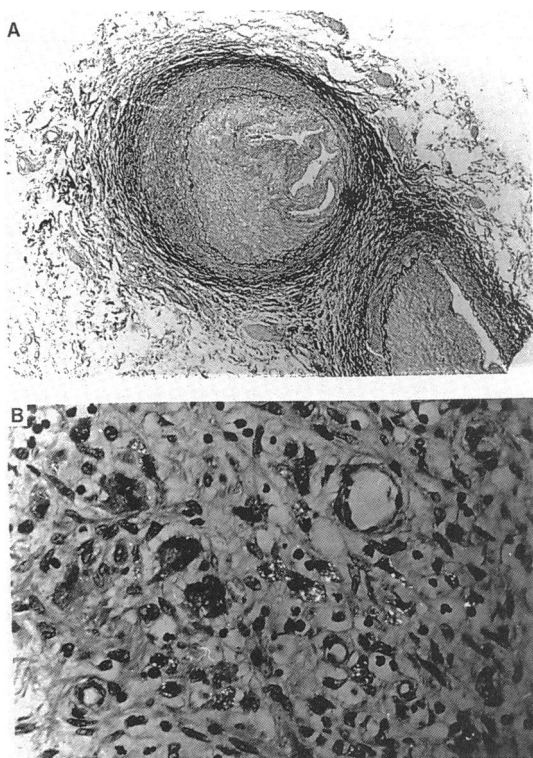
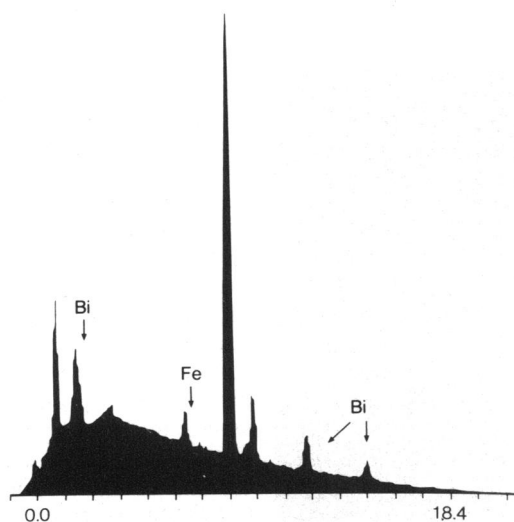


Figure 2 Electron probe x ray analysis of the refractile material within the thrombus showed an excess of bismuth (catheter derived) and iron (haemosiderin).



ventricle may not prove fatal because this ventricle supplies the low resistance pulmonary circulation. In transposition of the great arteries with a ventricular septal defect left

ventricular preload is increased and afterload reduced. The apparent return to normal left ventricular function (fractional shortening 36%) was misleading and the inevitable increase in afterload that occurred after anatomical correction resulted in intractable cardiac failure. If the degree of left ventricular dysfunction had been recognised we would have opted for an inflow correction, leaving the right ventricle as the systemic chamber.

Electron probe x ray analysis is a method of in situ elemental analysis that has the unique ability to relate chemical composition to tissue morphology. The technique combines high sensitivity (as little as  $10^{-19}$  g of an element will be detected) with near total specificity. The refractile material found in the lumen of the occluded circumflex coronary artery contained bismuth salts, which are frequently used to make catheters radio-opaque.

The pathological findings and clinical history provide conclusive evidence that coronary artery thrombosis occurred at the time of cardiac catheterisation. No damage to the catheters was noted during the procedure and we assume that the fragment arose from within the lumen. Winding showed the large number of particles released when cardiac catheters are flushed and the increased risk after one insertion of a guide wire.<sup>2</sup> Other evidence also suggests an increased risk of fragment separation from re-used catheters.<sup>3</sup> In our case several guide wire insertions were performed during a technically difficult procedure. Clinically important paradoxical coronary embolisation is rare<sup>4</sup> and, to our knowledge, paradoxical coronary embolisation of catheter-derived material has not previously been reported. The present trend toward interventional catheterisation and the extensive use of guide wires highlights the continuing need for improved catheter technology.

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